(No Model.) 3 Sheets—Sheet 1.

E. A. UEHLING.

APPARATUS FOR AND METHOD OF CASTING AND CONVEYING METALS.

No. 548,146. Patented Oct. 15, 1895.

Fig. 5.

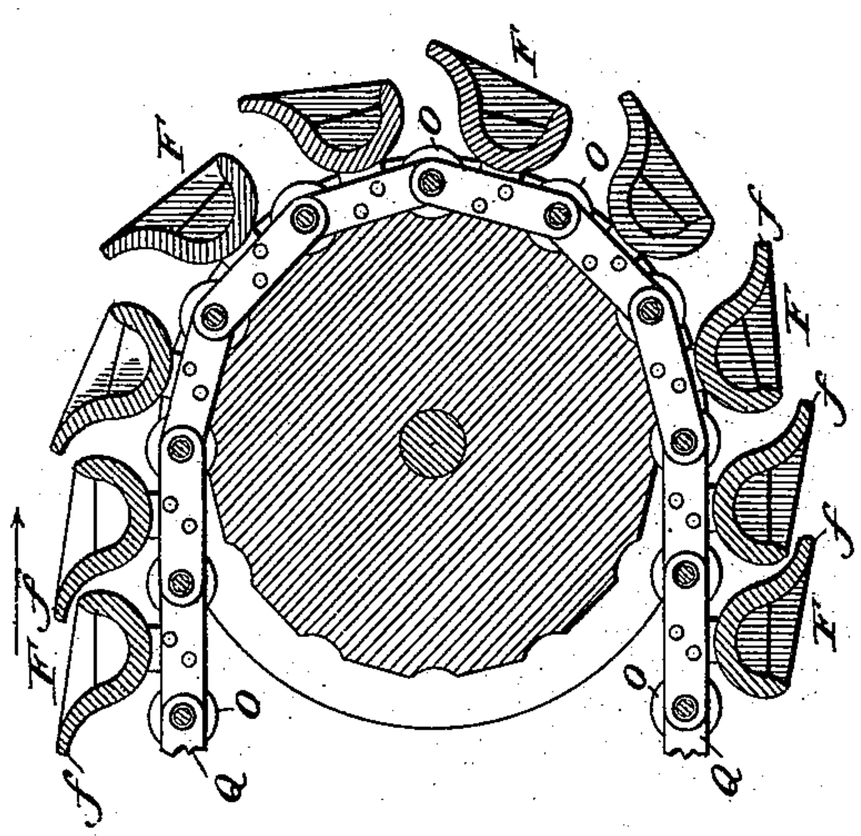

Fig. 1.

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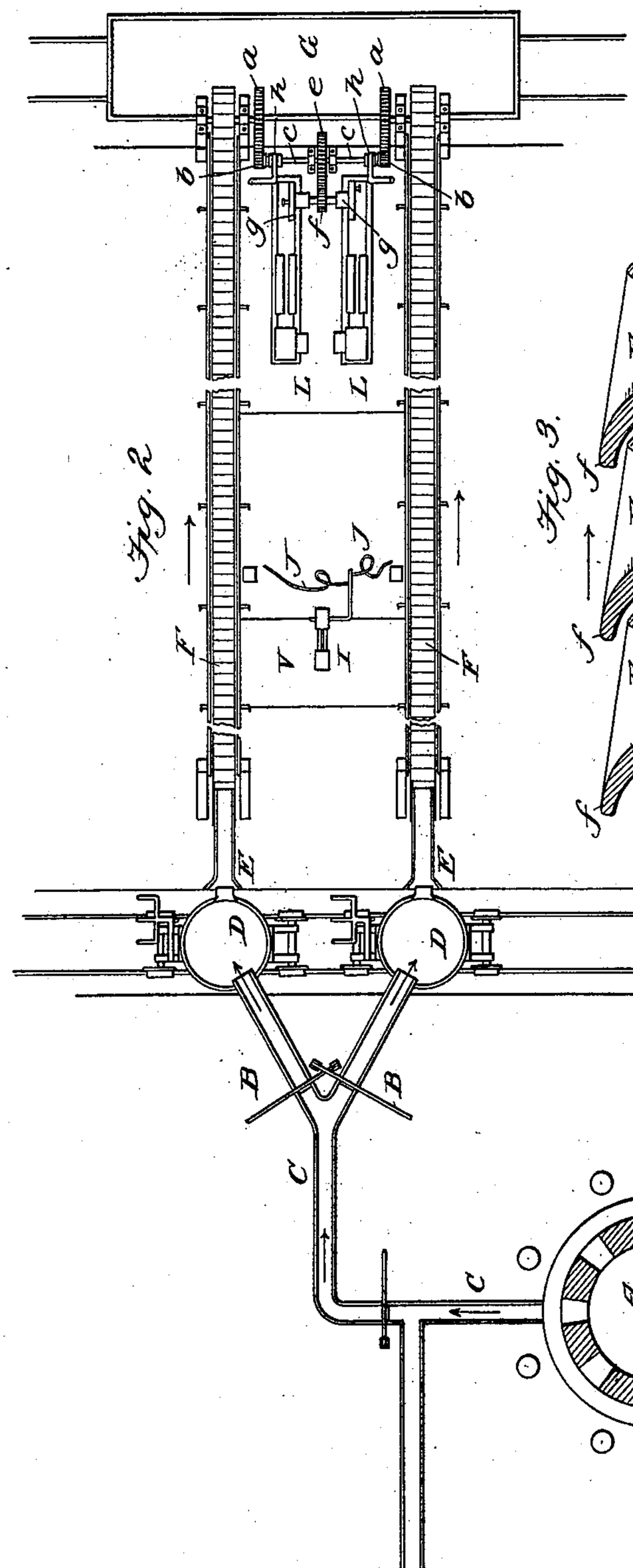

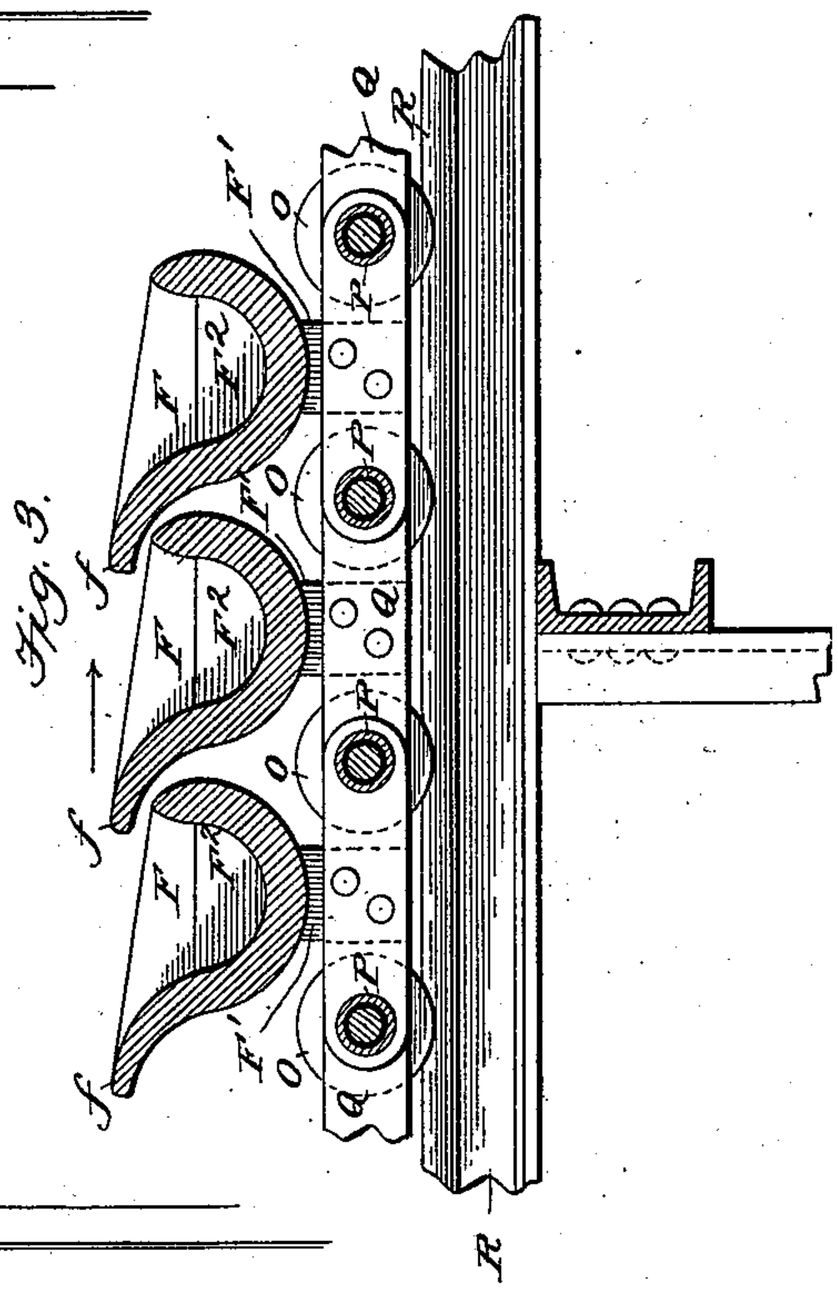

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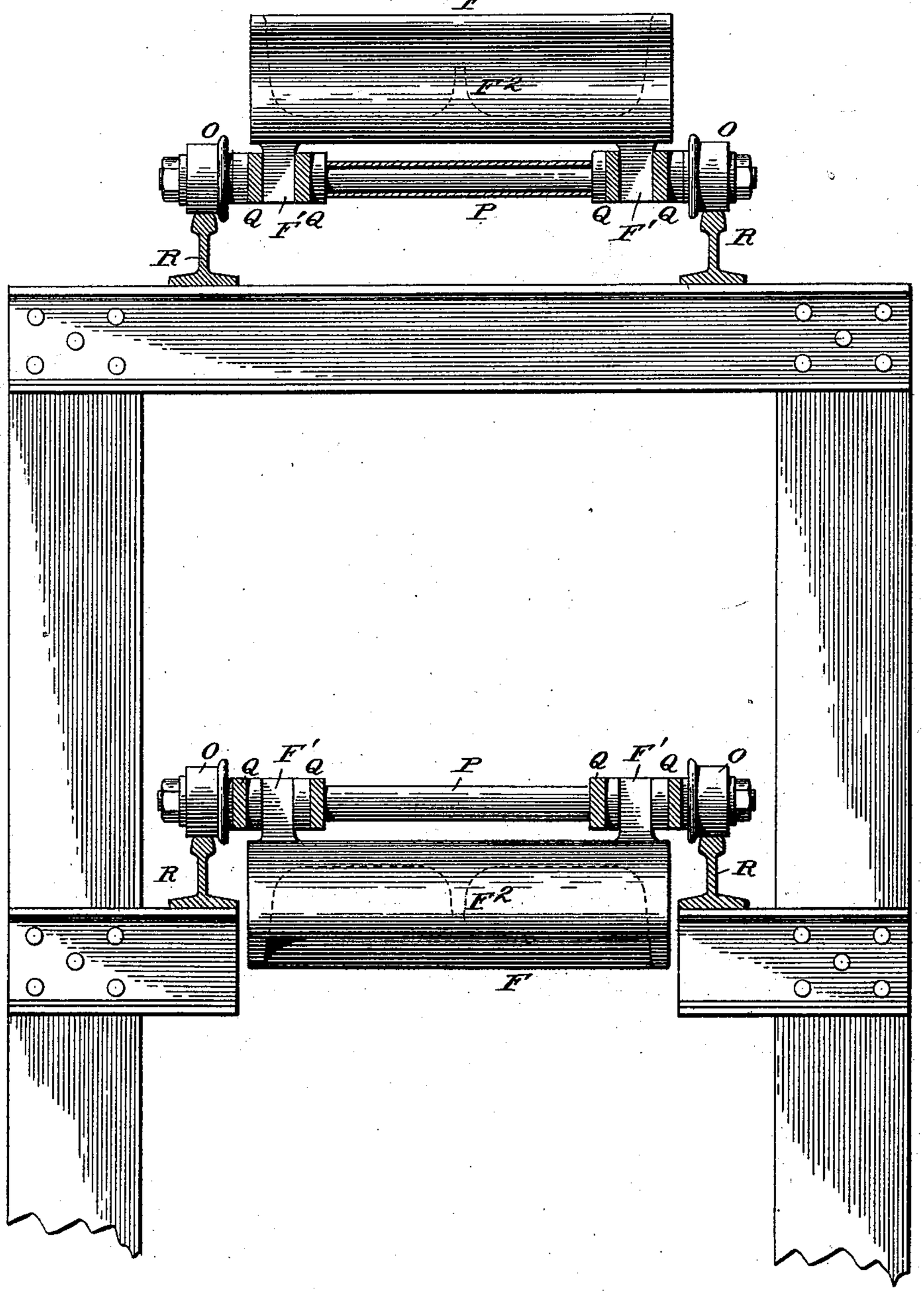
Fig. 4.



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APPARATUS FOR AND METHOD OF CASTING AND CONVEYING METALS.

SPECIFICATION forming part of Letters Patent No. 548,146, dated October 15, 1895.

Application filed November 28, 1894. Serial No. 530,253. (No model.)

To all whom it may concern:

Be it known that I, EDWARD A. UEHLING, a citizen of the United States, residing at Birmingham, in the county of Jefferson and State of Alabama, have invented certain new and useful Improvements in Apparatus and Methods for Casting and Conveying Metal from Smelting-Furnaces, of which the following is a specification.

In the casting and handling of pig-iron as now generally practiced the iron is run into open sand-molds called "pigs." In this operation the iron runs direct from the furnace into a long sand-runner, from which side runners are led off, called "sows," which feed the "pigs." The sows are cut off from the main runner as the "pig-beds" fill up, but the pigs must be detached from the sows and the latter broken into proper lengths for handling after the iron has set. This breaking off is done either while the iron is still red hot in the beds, making it an exceedingly-hard task, or the iron is left to cool, in which case heavy bars and sledge-hammers are required to break the pigs off the sows and then break the latter into proper lengths. After this breaking water is sprayed over the iron, and when it has sufficiently cooled is gathered, loaded on trams, and taken to the yard, where it is piled. The scrap is then gathered from the beds and the sand is wet down and molded up for another cast. These operations must be repeated from four to six times a day to take care of the product of a modern blast-furnace, and they depend almost entirely upon the brute force and physical endurance of the operators. The product is rough and irregular and the operation is very wasteful, producing large quantities of scrap, which must be remelted, and carries much sand with the iron, which reduces the value of the iron. Moreover, this method of running the iron from the furnace into the sand is under very poor control. It sometimes runs so slowly that the iron chills in the long runner before it reaches the lower pig-beds. At other times the running of the iron is with such a rush that the cores, which form the partitions between the pig-molds, are washed away and the beds sheeted. In either case the iron must be taken up from the sand-beds and remelted to make it marketable, besides the expense of having to break it up and remove it from the beds. The method above stated has also the disadvantage that the iron, as it runs from the furnace, is frequently of varying quality, and it is of common occurrence that several grades of iron are run from the furnace at the same cast. In this it not infrequently happens that a portion of the pig is deficient in those elements which are necessary to constitute good cast-iron—as, for example, silicon and graphitic carbon—while another portion has an excess of these elements. In either the iron has less value than it would have if the elements were properly mixed. In addition to all this much difficulty is often experienced in keeping the slag from running with and contaminating the iron, as well as preventing some of the iron from being wasted with the slag.

To avoid the disadvantages and difficulties above stated and to reduce the cost of the production and improve the quality of the product is the object of my invention, and which embraces a novel construction of plant, in which the metal is run from the furnace into a large reservoir, so mounted that it can be brought in communication with a series of movable molds, and its contents can be poured into the latter in a continuous and perfectly-controlled stream, forming pigs of uniform size, which solidify on their way to the dumping end, where they are automatically delivered into a car or other suitable conveyance.

Iron as tapped from a blast-furnace when working in good condition is highly superheated, and when run direct from the furnace through a short runner into a supply-reservoir of large capacity will retain its fluidity for several hours. In the employment of such reservoir there is therefore time and opportunity not only to thoroughly mix the contents of the reservoir, but also to sample the same and, if desirable, treat the iron in any manner that may seem expedient to improve its quality or change its character before tapping it into molds.

In the accompanying drawings I have illustrated an iron-casting plant embodying all the features of improvement which constitute my invention. These improvements in apparatus are not, however, all necessarily

connected or combined in this way, but they, or some of them, may be employed in metal-casting plants otherwise different in general operation and construction.

In the drawings, Figure 1 represents, in side elevation, a metal casting and conveying plant embodying my invention. Fig. 2 is a top view or plan of the same. Fig. 3 is an enlarged sectional view showing the construction and relation of the molds to each other and a portion of the endless truck-carrier for the molds. Fig. 4 shows, in enlarged transverse section, the mold-carriers and their supporting-frame; and Fig. 5 shows the mold-carrier and one of its guide-drums in section.

In the drawings I have shown a plant of machinery whereby my invention may be carried into effect and wherein the furnace A, in which the charge of iron is melted, is shown in connection with a comparatively short iron runway C, by which the charge is conveyed to and delivered into a reservoir D, wherein it is mixed, and from which the metal is continuously poured into a spout E, which leads into the molds F of a continuously-traveling endless carrier, the molds whereof are constructed to operate as an endless traveling casting-platform, and while in motion are coated with a refractory material. The tilting-reservoir and the endless carrier of molds are of such construction and corelation and are operated in such manner that the separate molds will be evenly filled and the operation of casting rendered continuous for the charge collected in the reservoir. The runway is provided with suitable controlling-gates B, and the reservoir into which the runway leads is suitably mounted to deliver the molten iron into the spout E, which has a fixed relation to the receiving end of the mold-carrier, while at the other end of the latter the pigs are dropped into a car G or suitable conveyer, to be carried where desired.

The reservoir D is mounted on a plane below the iron runway, and the endless mold-carrier, by means of wheels, is mounted below the spout upon rails, so that the molds will travel from and in the line of the spout.

The carrier for the molds is constructed of links Q, the ends of which are connected in endless relation by axles, the ends of which have loose flanged wheels O, running on rails R outside of the links. The rails are secured in a supporting structure, so that the flanged wheels will be supported alike at the upper and at the under traveling sides of the endless mold-carrier, while the carrier is maintained in position upon the supporting structure by a suitable drum mounted in each end of the structure. The respective drum-shafts at the delivery ends of the mold-carriers are connected by suitable mechanism with an engine L, by which either or both of the carriers can be operated, as may be required.

The molds or buckets are of a size and shape suitable for forming the pigs, and they are fixed, by means of lugs F′ on their bottom sides, to the links, so that each mold is caused to turn over at the end of the carrier to deliver the pig and to bring the upper side of the mold down in its travel back to the spout, where the open side of the mold is again turned uppermost to be again filled.

One side of each mold is extended so as to form an upward-curved lip *f*, adapted to overhang the side of the contiguous mold, so as to form a lapping guard or shield over the space between the molds, and thereby prevent the metal, as it is poured from the spout, from falling between the molds. This function of the lapping-lip is brought into action as the open sides of the molds turn up to receive the metal poured from the spout, and as the molds so turn up the lip stands toward the spout and over the side of the contiguous mold. This is very important, because the flow of the metal from the spout and the travel of the mold-carrier are both made continuous.

To make the pigs of convenient size without decreasing the capacity of the molds, I prefer to make them of a length twice that of the "pig-bar" and divide the mold by a transverse rib or partition F^2, (seen in Fig. 4,) such partition, however, preferably, only partially dividing the pig-bar, so that it will be freely dumped as a single bar from the mold and afterward broken apart, thus giving the advantage of molding two pigs in the same traveling mold at the same time.

The reservoir is of comparatively large size, and for iron may vary between forty and fifty tons capacity. I prefer a size such as will be sufficient to contain a full cast of the furnace it is designed to serve. The large capacity is important for the purpose of carrying out my invention to the best advantage, because large quantities of molten metal will insure a more uniform mixture and will also retain its fluidity a longer time, so that the metal may be tested, thoroughly mixed, and, if desirable, otherwise treated before pouring into the molds. The reservoirs are provided with approved mechanism by which the flow of the metal into the molds is kept under perfect control of the operator. Since the speed with which the empty molds are brought under the stream of metal flowing from the reservoir is also under perfect control, the combination of the reservoir, with the furnace and the molds, secures not only a uniform quality of metal, but also a uniform size of pigs, and avoids all loss in scrap.

The length of the mold-carrier must be such that the metal shall have time to solidify before it reaches the end where the pigs are dumped, and depends upon the temperature of fusion and the specific heat of the metal for which the plant is designed, lead requiring a much shorter mold-carrier than iron. It further depends upon the speed with which the metal is poured. For iron poured at a moderate speed fifty feet may be considered the minimum safe length. It is also impor-

tant to prevent the molten metal from "freezing" or sticking fast to the molds, and for this purpose I provide for applying to the empty molds while they are traveling back a film or coating of refractory material to which the metal will not adhere.

For iron to be used in puddling or steel furnaces, where a chilled iron is an advantage, a film or coating of fire-clay answers the purpose; but for irons to be used in castings, more especially such as require machining, a film or coating of fire-clay is inadmissible, and a coating of carbonaceous material, preferably of graphite, must be used, and which at the same time will serve to improve the quality of the iron. Loam or clay, and especially fire-clay, are the materials mostly used for coating molds to prevent the hot metal from sticking to and destroying the molds. Carbonaceous material, and especially graphite, is much more expensive and is employed only when, in addition to preventing the iron from sticking in the molds, to also prevent the chilling effect of the iron on the molds. For automatically applying such film I arrange beneath the lower empty side of the carrier a reservoir V, preferably with upwardly-inclining sides, and forming a dashboard for containing a supply of the material with which the molds are to be coated and which is in liquid form, the coating substance being mixed with water to such a consistency that it will impart to the molds a film or coating of the required thickness. At the reservoir is placed a suitable pump I, in communication with the reservoir and having hose connections J, which are provided with spraying-nozzles, which are controlled by an operator, who occupies a position beneath the carrier and constantly directs the spray into the molds on their return movement after having dumped the pigs. As the fluid is sprayed upon the walls of the molds during their return movement to again receive the metal, the surplus fluid will run from the molds down into the reservoir, to be again injected into the molds. It is important to notice that as the coating fluid is projected upward by force from the nozzle the provision of the reservoir-dashboard serves to catch the splashing fluid, and for this purpose the dashboard extends up in close proximity to the under side of the molds and preferably in a direction toward the dumping end of the mold-carrier, so that as the fluid is thrown into the mold the splashing back will be collected by the dashboard. While the lower empty molds are being thus coated to prevent the iron sticking to them, the heat from the upper filled molds will, by radiation, so greatly increase the heat of the lower empty molds as to dry the coating thoroughly before the molds reach the point where they are again filled with the molten metal. As this spraying of the coating substance is under free control of an operator in manipulating a spraying-nozzle, the coating of the molds is made uniform and easily effected. This method of coating the molds on the lower side of the carrier, while on its upper side the carrier-molds are both being filled and emptied, occasions no delay in the casting operation.

My invention can be carried out with one fixed reservoir and one mold-carrier for each furnace; but in practice I prefer to have duplicate mold-carriers and reservoirs, and prefer to have the latter mounted on trucks running on rails, as shown, so that either reservoir may be placed in communication with either mold-carrier. When two or more furnaces of the same plant are equipped with my invention, the reservoirs are interchangeable, and also the metal from one furnace can be transported in the reservoir of one furnace to and poured into the molds of another furnace, by which delays, which might result from accident to any part of the casting-plant, are avoided. The mold-carriers are not necessarily placed in close proximity to the furnace the metal from which they are to receive, but in plants consisting of several furnaces are preferable in a centrally-located casting-house, and the time of "casting" the furnaces may be so timed that one will follow the other, thus making the operation of pouring the metal almost continuous and giving the advantage that one crew will be able to do the pouring of all the furnaces, instead of having a crew for each furnace. Moreover, in such plant the equipment necessary for one furnace will answer for two or more.

In the operation the furnace is tapped and the slag is separated in the usual way and the iron is run into the reservoir, wherein it is thoroughly mixed by rabbling or by other means treated to improve its quality or make it more suitable for a special purpose. After the reservoir containing the metal to be poured has been brought into proper position for delivering its contents into the spout E and the mold-carrier set in motion by an engine L, the reservoir is tilted or tapped into the iron poured into the spout from which it runs into the molds, which turn upward at the end of the carrier, just under the delivery end of the spout, and are filled as they move outwardly in the way stated and deliver the pigs at the end of the carrier. While the casting operation is thus effected on the upper side of the endless mold-carrier, the operation of coating the empty molds on the under side of the carrier is simultaneously effected from beneath the endless carrier. To obtain the best results in coating the molds the spraying of the coating material into the molds is made in a direction opposite to the travel of the molds; but it is obvious that the direction of the spray may be in the same direction as the travel of the empty molds. To effect the speedy drying of the coating in the molds the return lower side of the carrier should travel as near as practicable to the upper casting side of the carrier to get the best effect of the radiated heat therefrom upon the

bottoms of the coated molds. The carrier forms a continuous revolving truck for the molds, and to prevent the undue heating of the axles from the metal in the molds I provide the axles with sleeves P of some suitable material.

I prefer that the flanged wheels shall be made to revolve and not the axles.

It is important that the molds shall have a fixed relation to the links of the endless carrier and that they shall be so fixed between the axles of their rolling supports, because by such construction the molds are inverted to discharge the pigs, such inversion being effected by the passing of the rolling supports over the guide-drum of the driving-gear, and which guide-drum also operates the carrier by its connected gearing. In Fig. 2 the engines and the gearing which connects them to the endless mold-carriers are shown as being located between the mold-carriers, and such gearing consists of a gear *a* on the guide-drum of each carrier, which, respectively, engage a pinion *b* on a shaft *c*, which has a gear *e*, which engages a pinion *f* on a double crank-shaft *g*, which at each end connects with the engine. Suitable clutch devices *h* control the connection of the engines with the independent mold-carriers.

As a means of hastening the cooling of the metal in the molds, water may be sprayed thereon from sprinklers suitably arranged above the molds, as shown in Fig. 1.

W is the reservoir for collecting the slag.

It is to be understood that changes in the form, proportions, and manner of details of construction as are embraced in the terms of the concluding claims may be resorted to without departing from the principle or sacrificing any of the advantages of this invention, and that parts of my invention may be used separately or together, or in connection with other equivalent parts.

Having described a metal-casting plant embodying in preferred form the several features of my invention in combination, what I separately claim, and desire to secure by Letters Patent, is—

1. The herein described method of casting pig metal which consists in collecting the metal from the furnace in a reservoir, bringing said reservoir into communication with an endless connected series of molds, pouring the metal from the reservoir in a controllable continuous stream into said molds, and moving the latter continuously at such a speed that they will be uniformly filled, automatically and continuously deliver the pigs at the opposite end and continuously injecting refractory material into the empty molds as they return to be refilled with molten metal.

2. In the manufacture of pig-iron, the combination, with an endless traveling connected series of molds, a reservoir for continuously supplying the said traveling molds with molten metal, of forcing mechanism in communication with a reservoir containing a refractory liquid substance and suitable means connecting said forcing mechanism with refractory liquid for injecting the liquid in a spray into the empty molds for the purpose stated.

3. In the manufacture of pig-iron, the combination with an endless traveling connected series of molds, a reservoir and a spout for continuously supplying the said traveling molds with molten metal, and a reservoir for containing a refractory liquid substance, having a dashboard inclined upward in close proximity to the molds, of spraying mechanism in communication with said refractory substance arranged to inject the fluid into the empty molds above the dash board.

4. In the manufacture of pig-iron, the combination, with an endless connected series of molds, means for supplying them with molten metal, a reservoir for containing a liquid refractory substance for coating the molds, a pump in communication with said liquid, a hose and a spray-nozzle connecting said pump, and means for operating said mold in a circuit, for the purpose stated.

5. The combination in a metal casting plant, of a reservoir for receiving the molten metal from the furnace, an endless connected series of molds, a spout connecting the reservoir and series of molds, mechanism for projecting in spray a coating of refractory substance into the empty molds and suitable means for operating the molds in a circuit.

6. A plant for the manufacture of pig-iron consisting of a furnace for smelting ores, a series of endless connected molds in parallel relation, a reservoir for supplying each connected set of molds, engines for driving either set of molds separately or both together, mechanism for spraying the empty molds with a refractory substance, and a divided spout having independent cut-offs for directing the molten metal from the furnace to either or both of the reservoirs, substantially as described.

7. For casting pig-iron, a plant having arranged side by side two or more independent series of connected molds forming endless casting platforms, the molds whereof have their contiguous edges overlapping and are mounted upon rolling supports, fixed ways for such supports, a spout at one end of each set of molds, a blast furnace and reservoirs communicating between the mold-carriers and blast furnace, a driving mechanism in connection with each set of molds, an engine, and mechanism for connecting it to the driving gear of the said set of molds, a reservoir for containing a mixture of refractory material and spraying devices for the refractory material for operation substantially as dedescribed.

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